

Stormwater Filter Inspection and Maintenance Specs

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StormFilter Inspection and Maintenance Procedures



Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. Inspection

- Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

- Cartridge replacement
- Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..





Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
 - a. If $>4"$ of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
 - a. If $>1/4"$ of accumulation, maintenance is required.
3. Submerged cartridges.
 - a. If $>4"$ of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
 - a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
 - a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
 - a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
 - a. If pronounced scum line (say $\geq 1/4"$ thick) is present above top cap, maintenance is required.



Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

- B. Remove the used cartridges (up to 250 lbs. each) from the vault.



Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps a through c until all cartridges have been removed.

Method 2:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood and float.
- D. At location under structure access, tip the cartridge on its side.
- E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
- F. Set the empty, used cartridge aside or load onto the hauling truck.
- G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.



Inspection Report

Date: Personnel:

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:



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Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

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CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit that can contain up to four StormFilter cartridges. The steel CBSF is offered both as a standard and as a deep unit.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. It can also be fitted with an inlet pipe for roof leaders or similar applications.

The CBSF unit treats peak water quality design flows up to 0.13 cfs, coupled with an internal weir overflow capacity of 1.0 cfs for the standard unit, and 1.8 cfs for the deep steel and concrete units. Plastic units have an internal weir overflow capacity of 0.5 cfs.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas and for other non-traffic-bearing applications.

The CBSF consists of a sumped inlet chamber and a cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed under the baffle and into the cartridge chamber through a port between the baffle and the overflow weir.

Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed by an under-drain manifold to the outlet pipe on the downstream side of the overflow weir and discharged.

When flows into the CBSF exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that are flat and have little available hydraulic head to spare. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF. The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re-piping the storm system.



CatchBasin StormFilter™**Maintenance Guidelines**

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight 100 lbs. each).
3. Turn cartridge(s) counter-clockwise to disconnect from pipe manifold.
4. Remove 4" center cap from cartridge and replace with lifting cap.
5. Remove cartridge(s) from catch basin by hand or with vactor truck boom.
6. Remove accumulated sediment via vactor truck (min. clearance 13" x 24").
7. Remove accumulated sediment from cartridge bay. (min. clearance 9.25" x 11").
8. Rinse interior of both bays and vactor remaining water and sediment.
9. Install fresh cartridge(s) threading clockwise to pipe manifold.
10. Replace cover and grate.
11. Return original cartridges to Contech for cleaning.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure. Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to Contech as appropriate.

Materials required include a lifting cap, vactor truck and fresh filter cartridges. Contact Contech for specifications and availability of the lifting cap. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance. the owner may refresh spent cartridges. Refreshed cartridges are also available from Contech on an exchange basis. Contact the maintenance department of Contech at 503-258-3157 for more information.

Maintenance is estimated at 26 minutes of site time. For units with more than one cartridge, add approximately 5 minutes for each additional cartridge. Add travel time as required.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance.
3. Use of larvicides containing *Bacillus thuringiensis israelensis* (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer's recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit http://www.summitchemical.com/mos_ctrl/default.htm.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter by string or wire to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following: <http://www.ucmrp.ucdavis.edu/publications/managingmosquitoesstormwater8125.pdf>

Vortechs[®] Guide Operation, Design, Performance and Maintenance



Vortechs®

The Vortechs system is a high-performance hydrodynamic separator that effectively removes finer sediment (e.g. 50-microns (μm), oil, and floating and sinking debris. The swirl concentration operation and flow controls work together to minimize turbulence and provide stable storage of captured pollutants. Precast models can treat peak design flows up to 30-cfs (850-L/s); cast-in-place models handle even greater flows. A typical system is sized to provide a specific removal efficiency of a predefined particle size distribution (PSD).

Operation Overview

Stormwater enters the swirl chamber inducing a gentle swirling flow pattern and enhancing gravitational separation. Sinking pollutants stay in the swirl chamber while floatables are stopped at the baffle wall. Vortechs systems are usually sized to efficiently treat the frequently occurring runoff events and are primarily controlled by the low flow control orifice. This orifice effectively reduces inflow velocity and turbulence by inducing a slight backwater that is appropriate to the site.

During larger storms, the water level rises above the low flow control orifice and begins to flow through the high flow control. Any layer of floating pollutants is elevated above the invert of the Floatables Baffle Wall, preventing release. Swirling action increases in relation to the storm intensity, while sediment pile remains stable. When the storm drain is flowing at peak capacity, the water surface in the system approaches the top of the high flow control. The Vortechs system will be sized large enough so that previously captured pollutants are retained in the system, even during these infrequent events.

As a storm subsides, treated runoff decants out of the Vortechs system at a controlled rate, restoring the water level to a dry-weather level equal to the invert of the inlet pipe. The low water level facilitates easier inspection and cleaning, and significantly reduces maintenance costs by reducing pump-out volume.

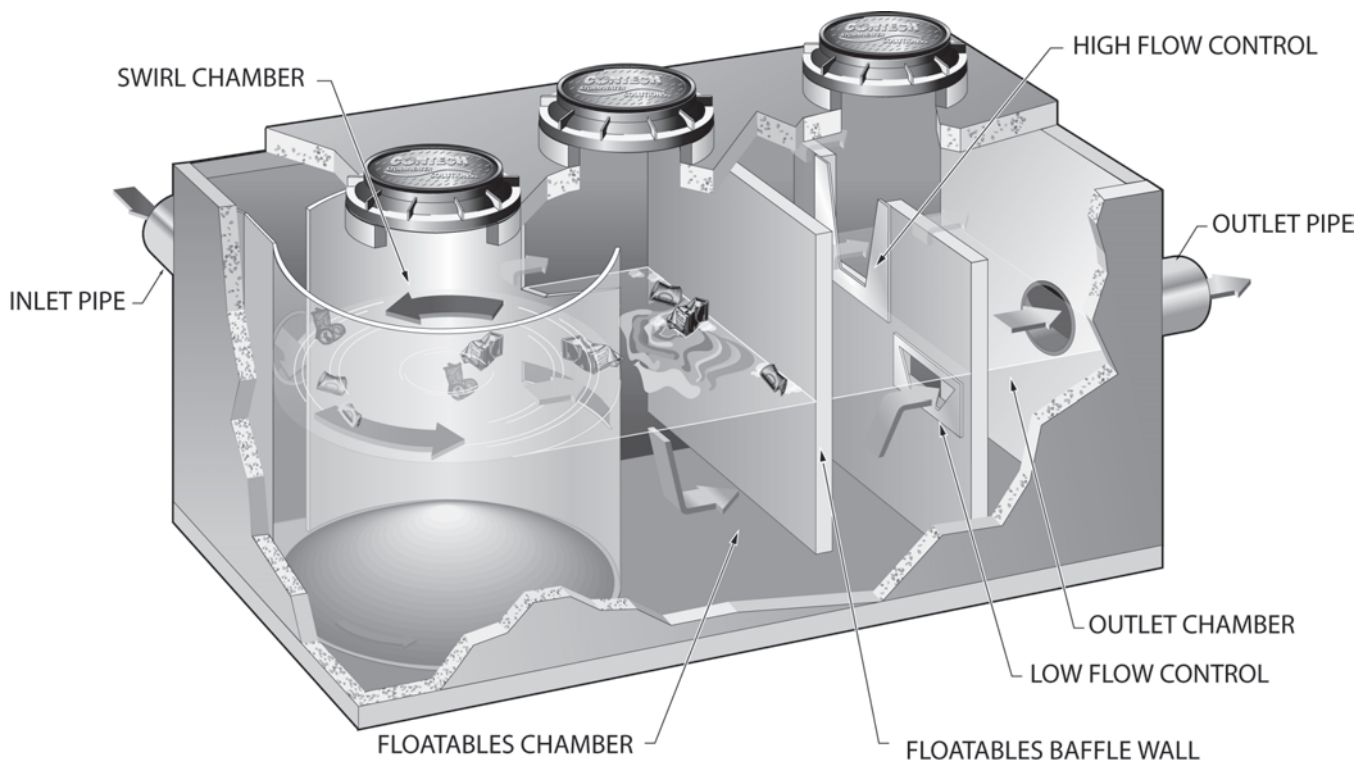
Design Basics

Each Vortechs system is custom designed based on site size, site runoff coefficient, regional precipitation intensity distribution, and anticipated pollutant characteristics. There are two primary methods of sizing a Vortechs system. The first is to determine which model size provides the desired removal efficiency at a given flow for a defined particle size or PSD. The second and more in depth method is the summation of Rational Rainfall Method™ which uses a summation process described below in detail and is used when a specific removal efficiency of the net annual sediment load is required.

Typically Vortechs systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for either 50- μm particles, or a particle gradation found in typical urban runoff (see performance section of this manual for more information).

The Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.



Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes or hourly and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed Vortechs system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Once a system size is established, the internal elements of the system are designed based on information provided by the site engineer. Flow control sizes and shapes, sump depth, oil spill storage capacity, sediment storage volume and inlet and outlet orientation are determined for each system. In addition, bypass weir calculations are made for off-line systems.

Flow Control Calculations

Low Flow Control

The low flow control, or orifice, is typically sized to submerge the inlet pipe when the Vortechs system is operating at 20% of its treatment capacity. The orifice is typically a Cippoletti shaped aperture defined by its flat crest and sides which incline outwardly at a slope of 1 horizontal to 4 vertical.

$$Q_{\text{orifice}} = C_d \cdot A \cdot \sqrt{2gh}$$

Where:

Q_{orifice} = flow through orifice, cfs (L/s)

C_d = orifice coefficient of discharge = 0.56 (based on lab tests)

A = orifice flow area, ft² (m²) (calculated by orifice geometry)

h = design head, ft (m) (equal to the inlet pipe diameter)

g = acceleration due to gravity (32.2-ft/s² (9.81-m/s²))

The minimum orifice crest length is 3-in (76-mm) and the minimum orifice height is 4-in (102-mm). If flow must be restricted beyond what can be provided by this size aperture, a Fluidic-Amp™ HydroBrake flow control will be used. The HydroBrake allows the minimum flow constriction to remain at 3-in (76-mm) or greater while further reducing flow due to its unique throttling action.

High Flow Control

The high flow control, or weir, is sized to pass the peak system capacity minus the peak orifice flow when the water surface elevation is at the top of the weir. This flow control is also a Cippoletti type weir.

The weir flow control is sized by solving for the crest length and head in the following equation:

$$Q_{\text{weir}} = C_d \cdot L \cdot (h)^{3/2}$$

Where:

Q_{weir} = flow through weir, cfs (L/s)

C_d = Cippoletti weir coefficient = 3.37 (based on lab testing)

h = available head, ft (m) (height of weir)

L = design weir crest length, ft (m)

Bypass Calculations

In most all cases, pollutant removal goals can be met without treating peak flow rates and it is most feasible to use a smaller Vortechs system configured with an external bypass. In such cases, a bypass design is recommended by Contech Engineered Solutions for each off-line system. To calculate the bypass capacity, first subtract the system's treatment capacity from the peak conveyance capacity of the collection system (minimum of 10-year recurrence interval). The result is the flow rate that must be bypassed to avoid surcharging the Vortechs system. Then use the following arrangement of the Francis formula to calculate the depth of flow over the bypass weir.

$$H = (Q_{\text{bypass}} / (C_d \cdot L))^{2/3}$$

Where:

H = depth of flow over bypass weir crest, ft (m)

Q_{bypass} = required bypass flow, cfs (L/s)

C_d = discharge coefficient = 3.3 for rectangular weir

L = length of bypass weir crest, ft

The bypass weir crest elevation is then calculated to be the elevation at the top of the Cippoletti weir minus the depth of flow.

Hydraulic Capacity

In the event that the peak design flow from the site is exceeded, it is important that the Vortechs system is not a constriction to runoff leaving the site. Therefore, each system is designed with enough hydraulic capacity to pass the 100-year flow rate. It is important to note that at operating rates above 100-gpm/ft² (68-Lps/m²) of the swirl chamber area (peak treatment capacity), captured pollutants may be lost.

When the system is operating at peak hydraulic capacity, water will be flowing through the gap over the top of the flow control wall as well as the orifice and the weir.

Performance

Full Scale Laboratory Test Results

Laboratory testing was conducted on a full scale Vortechs model 2000. The 150- μm curve demonstrates the results of tests using particles that passed through a 60-mesh sieve and were retained on a 100-mesh sieve. The 50- μm curve is based on tests of particles passing through a 200-mesh sieve and retained on a 400-mesh sieve (38- μm). A gradation with an average particle size (d50) of 80- μm , containing particles ranging from 38–500- μm in diameter was used to represent typical stormwater solids. (Table 1)

Particle Size Distribution (μm)	Percentage of Sample Make-Up
< 63	42%
63 - 75	4%
75 - 100	9%
100 - 150	7%
150 - 250	11%
> 250	27%

Table 1: Particle gradation of typical urban runoff used for efficiency curve

As shown, the Vortechs system maintains positive total suspended solids (TSS), defined by the tested gradations, removal efficiencies over the full range of operating rates. This allows the system to effectively treat all runoff from large, infrequent design storms, as well as runoff from more frequent low-intensity storms.

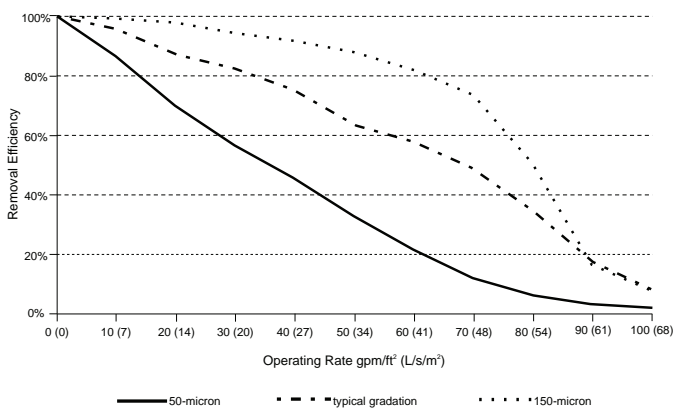


Figure 1: Vortechs model 2000 Removal Efficiencies

Typical Vortechs systems are designed to treat peak flows from 1.6-cfs (45-L/s) up to 30-cfs (850-L/s) online without the need for bypass. However, external bypasses can be configured to convey peak flows around the system if treatment capacity is exceeded. The system can also be configured to direct low flows from the last chamber of the system to polishing treatment when more stringent water quality standards are imposed. In all configurations, high removal efficiencies are achieved during the lower intensity storms, which constitute the majority of annual rainfall volume.

Full report available at www.conteches.com/vortechs.

Laboratory Testing

Full reports available at www.conteches.com/vortechs

Technical Bulletin 1: Removal Efficiencies for Selected Particle Gradations

Technical Bulletin 2: Particle Distribution of Sediments and the Effect on Heavy Metal Removal

Technical Bulletin 3: Sizing for Net Annual Sediment Removal

Technical Bulletin 3a: Determining Bypass Weir Elevation for Off-Line Systems

Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method

Technical Bulletin 5: Oil Removal Efficiency

Field Monitoring

Following are brief summaries of the field tests completed to date.

Full reports available at www.conteches.com/vortechs

DeLorme Mapping Company

Yarmouth, ME

Contech Engineered Solutions

Prior to this premier field test of the Vortechs system, Contech developed an extensive body of laboratory data to document total suspended solids (TSS) removal efficiency. Contech performed this field study in order to compare the performance predicted using laboratory data to the performance of a correctly sized system in the field.

The study site was the headquarters of DeLorme Mapping in Yarmouth, Maine. The building, driveway, parking lot and ancillary facilities were constructed in 1996. A Vortechs model 11000 was installed to treat runoff from the 300-space, 4-acre (1.62-ha) parking lot.

Testing Period	May 1999 to Dec 1999
# of Storms Sampled	20
Mean Influent Concentration	328-mg/L
Mean Effluent Concentration	60-mg/L
Removal Efficiency	82%

The main purpose of the DeLorme study was to verify that the sizing methodology developed from our full-scale laboratory testing was valid and an accurate means of predicting field performance. The results of the study confirmed our sizing methodology.

Village Marine Drainage

Lake George, NY

New York State Department of Environmental Conservation, Division of Water

The New York State DEC used funds obtained in a Section 319 grant to initiate a study of the effectiveness of the Vortechs system to remove sediment and other pollutants transported

by stormwater to Lake George, Lake George Village, New York. "Since the 1970s, when there was a rapid increase in the rate and concentration of development along the southwestern shores of Lake George, we have been concerned about the impact of stormwater discharges into the lake," said Tracy West, co-author of the study.

Testing Period	Feb 2000 to Dec 2000
# of Storms Sampled	13
Mean Influent Concentration	801-mg/L
Mean Effluent Concentration	105-mg/L
Removal Efficiency	88%

The study concluded that the Village and Town of Lake George should consider installing additional Vortechs systems in areas where sedimentation and erosion have been identified as non-point source pollution problems.

Harding Township Rest Area Harding Township, NJ RTP Environmental Associates

This third party evaluation was performed under a U.S. Environmental Protection Agency grant, administered by the New Jersey Department of Environmental Protection. A. Roger Greenway, principal of RTP Environmental Associates, Inc., conducted the study in conjunction with Thonet Associates, which assisted with data analysis and helped develop best management practices (BMP) recommendations.

The Vortechs model 4000 was sized to handle a 100-year storm from the 3 acre (1.21 ha) paved parking area at the Harding Rest Stop, located off the northbound lane of I-287 in Harding Township, New Jersey.

Testing Period	May 1999 to Nov 2000
# of Storms Sampled	5
Mean Influent Concentration (TSS)	493-mg/L
Mean Effluent Concentration (TSS)	35-mg/L
Removal Efficiency (TSS)	93%
Mean Influent Concentration (TPH)	16-mg/L
Mean Effluent Concentration (TPH)	5-mg/L
Removal Efficiency (TPH)	67%

The study concluded that truck rest stops and similar parking areas would benefit from installing stormwater treatment systems to mitigate the water quality impacts associated with stormwater runoff from these sites.

Timothy Edwards Middle School

South Windsor, CT

UCONN Department of Civil & Environmental Engineering

This study of the Vortechs system was published as a thesis by Susan Mary Board, as part of the requirements for a Master of Science degree from the University of Connecticut. Her objective was to determine how well the Vortechs system retained pollutants from parking lot runoff, including total suspended solids (TSS), nutrients, metals, and petroleum hydrocarbons.

A Vortechs model 5000 was installed in 1998 to treat runoff from the 82-space parking lot of Timothy Edwards Middle School. The entire watershed was approximately 2 acres (0.81 ha), and was 80% impervious.

Testing Period	Jul 2000 to Apr 2001
# of Storms Sampled	weekly composite samples taken
Mean Influent Concentration	324-mg/L
Mean Effluent Concentration	73-mg/L
Removal Efficiency	77%

Additionally, the Vortechs system was particularly effective in removing zinc (85%), lead (46%), copper (56%), phosphorus (67%) and nitrate (54%).

The study concluded that the Vortechs system significantly reduced effluent concentrations of many pollutants in stormwater runoff.



Maintenance

The Vortechs system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, e.g., unstable soils or heavy winter sanding will cause the swirl chamber to fill more quickly but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is provided on the following page, and is also available on conteches.com.

The Vortechs system should be cleaned when inspection reveals that the sediment depth has accumulated to within 12 to 18 inches (300 to 450 mm) of the dry-weather water surface elevation. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

Cleaning

Cleaning of the Vortechs system should be done during dry weather conditions when no flow is entering the system. Clean-out of the Vortechs system with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. If such a truck is not available, a "clamshell" grab may be used, but it is difficult to remove all accumulated pollutants using a "clamshell".

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads to solidify the oil since these pads are usually much easier to remove from the unit individually and less expensive to dispose of than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Cleaning of a Vortechs system is typically done by inserting a vacuum hose into the swirl chamber and evacuating this chamber of water and pollutants. As water is evacuated, the water level outside of the swirl chamber will drop to a level roughly equal to the crest of the lower aperture of the swirl chamber.

Floating pollutants will decant into the swirl chamber as the water level is drawn down. This allows most floating material to be withdrawn from the same access point above the swirl chamber. Floating material that does not decant into the swirl chamber during draw down should be skimmed from the baffle chamber. Sediment may accumulate outside the swirl chamber. If this is the case, it may be necessary to pump out other chambers. It is advisable to check for sediment accumulation in all chambers during inspection and maintenance.

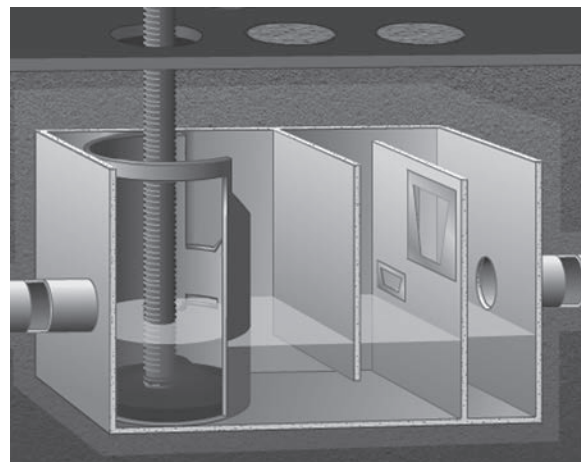
These maintenance recommendations apply to all Vortechs systems with the following exceptions:

1. It is strongly recommended that when cleaning systems larger than the Model 16000 the baffle chamber be drawn down to depth of three feet prior to beginning clean-out of the swirl chamber. Drawing down this chamber prior to the swirl chamber reduces adverse structural forces pushing upstream on the swirl chamber once that chamber is empty.
2. Entry into a Vortechs system is generally not required as cleaning can be done from the ground surface. However, if manned entry into a system is required the entire system should be evacuated of water prior to entry regardless of the system size.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the Vortechs system should be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

Contech has created a network of Certified Maintenance Providers (CCMP's) to provide maintenance on Vortechs systems. To find a CCMP in your area please visit www.conteches.com/maintenance.



Vortechs Inspection & Maintenance Log

Vortech Model: _____ Location: _____

[illegible]

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.



Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

800-338-1122

www.conteches.com

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Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treatment products. For information on other Contech division offerings, visit conteches.com or call 800.338.1122

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

Operation & Maintenance (OM) Manual v01



filtererra®
Bioretention Systems

CNTECH®
ENGINEERED SOLUTIONS



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- Filtererra General Description
- Filtererra Schematic
- Basic Operations
- Design

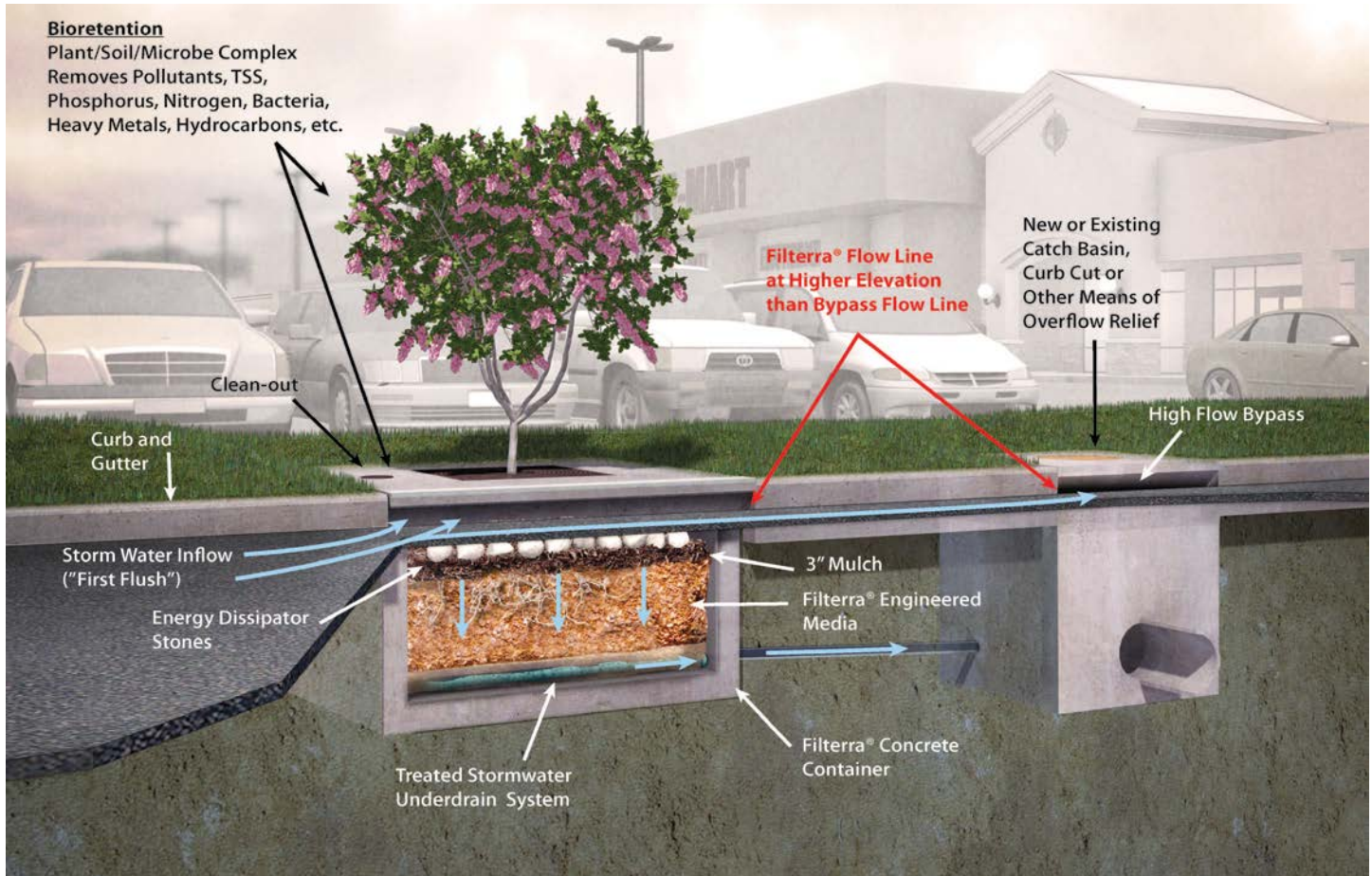
Maintenance

- Maintenance Overview
 - » Why Maintain?
 - » When to Maintain?
- Exclusion of Services
- Maintenance Visit Summary
- Maintenance Tools, Safety Equipment and Supplies
- Maintenance Visit Procedure
- Maintenance Checklist and Log



General Description

The following general specifications describe the general operations and maintenance requirements for the Contech Engineered Solutions LLC stormwater bioretention filtration system, the Filterra. The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, pre-constructed drop-in place unit designed for applications in the urban landscape to treat contaminated runoff.



Stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The mixture immobilizes pollutants which are then decomposed, volatilized and incorporated into the biomass of the Filterra system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. Higher flows bypass the Filterra to a downstream inlet or outfall. Maintenance is a simple, inexpensive and safe operation that does not require confined space access, pumping or vacuum equipment or specialized tools. Properly trained landscape personnel can effectively maintain Filterra Stormwater systems by following instructions in this manual.

Basic Operations

Filtterra is a bioretention system in a concrete box.

Contaminated stormwater runoff enters the filter box through the curb inlet spreading over the 3-inch layer of mulch on the surface of the filter media. As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the soil media where the finer particles are removed and other chemical reactions take place to immobilize and capture pollutants in the soil media. The cleansed water passes into an underdrain and flows to a pipe system or other appropriate discharge point. Once the pollutants are in the soil, the bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a very complex variety of biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

Design and Installation

Each project presents different scopes for the use of Filtterra systems. Information and help may be provided to the design engineer during the planning process. Correct Filtterra box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction. The contractor is responsible for the correct installation of Filtterra units as shown in approved plans. A comprehensive installation manual is available at www.conteches.com.

Maintenance

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement.

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the expected lifespan of your Filtterra media.
- Avoid more costly media replacement.
- Help reduce pollutant loads leaving your property.

Simple maintenance of the Filtterra is required to continue effective pollutant removal from stormwater runoff before discharge into downstream waters. This procedure will also extend the longevity of the living biofilter system. The unit will recycle and accumulate pollutants within the biomass, but is also subjected to other materials entering the throat. This may include trash, silt and leaves etc. which will be contained within the void below the top grate and above the mulch layer. Too much silt may inhibit the Filtterra's flow rate, which is the reason for site stabilization before activation. Regular replacement of the mulch stops accumulation of such sediment.

When to Maintain?

Contech includes a 1-year maintenance plan with each system purchase. Annual included maintenance consists of a maximum of two (2) scheduled visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as the unit installed, curb and gutter and transitions in place and activation (by Supplier) when mulch and plant are added and temporary throat protection removed.

Activation cannot be carried out until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands while the fall visit helps the system by removing excessive leaf litter.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required; regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency; e.g. some fast food restaurants require more frequent trash removal. Contributing drainage areas which are subject to new development wherein the recommended erosion and sediment control measures have not been implemented may require additional maintenance visits.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the Supplier and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the (maintenance) Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance to the Supplier (i.e. no pruning or fertilizing).

Exclusion of Services

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant of the Filterra system.

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the Supplier maintenance contract. Should a major contamination event occur the Owner must block off the outlet pipe of the Filterra (where the cleaned runoff drains to, such as drop inlet) and block off the throat of the Filterra. The Supplier should be informed immediately.

Maintenance Visit Summary

Each maintenance visit consists of the following simple tasks (detailed instructions below).

1. Inspection of Filterra and surrounding area
2. Removal of tree grate and erosion control stones
3. Removal of debris, trash and mulch
4. Mulch replacement
5. Plant health evaluation and pruning or replacement as necessary
6. Clean area around Filterra
7. Complete paperwork

Maintenance Tools, Safety Equipment and Supplies

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes. A T-Bar or crowbar should be used for moving the tree grates (up to 170 lbs ea.). Most visits require minor trash removal and a full replacement of mulch. See below for actual number of bagged mulch that is required in each unit size. Mulch should be a double shredded, hardwood variety; do not use colored or dyed mulch. Some visits may require additional Filterra engineered soil media available from the Supplier.

Box Length	Box Width	Filter Surface Area (ft ²)	Volume at 3" (ft ³)	# of 2 ft ³ Mulch Bags
4	4	4	4	2
6	4	6	6	3
8	4	8	8	4
6	6	9	9	5
8	6	12	12	6
10	6	15	15	8
12	6	18	18	9
13	7	23	23	12

Maintenance Visit Procedure

Keep sufficient documentation of maintenance actions to predict location specific maintenance frequencies and needs. An example Maintenance Report is included in this manual.



1. Inspection of Filterra and surrounding area

- Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

Record on Maintenance Report the following:

Standing Water	yes no
Damage to Box Structure	yes no
Damage to Grate	yes no
Is Bypass Clear	yes no

If yes answered to any of these observations, record with close-up photograph (numbered).



2. Removal of tree grate and erosion control stones

- Remove cast iron grates for access into Filterra box.
- Dig out silt (if any) and mulch and remove trash & foreign items.

Record on Maintenance Report the following:

Silt/Clay	yes no
Cups/ Bags	yes no
Leaves	yes no
Buckets Removed	_____



3. Removal of debris, trash and mulch

- After removal of mulch and debris, measure distance from the top of the Filterra engineered media soil to the bottom of the top slab. Compare the measured distance to the distance shown on the approved Contract Drawings for the system. Add Filterra media (not top soil or other) to bring media up as needed to distance indicated on drawings.

Record on Maintenance Report the following:

Distance to Bottom of Top Slab (inches)	_____
Inches of Media Added	_____



4. Mulch replacement

- Please see mulch specifications.
- Add double shredded mulch evenly across the entire unit to a depth of 3".
- Ensure correct repositioning of erosion control stones by the Filterra inlet to allow for entry of trash during a storm event.
- Replace Filterra grates correctly using appropriate lifting or moving tools, taking care not to damage the plant.



5. Plant health evaluation and pruning or replacement as necessary

- Examine the plant's health and replace if dead.
- Prune as necessary to encourage growth in the correct directions

Record on Maintenance Report the following:

Height above Grate	_____ (ft)
Width at Widest Point	_____ (ft)
Health	_____ alive dead
Damage to Plant	_____ yes no
Plant Replaced	_____ yes no



6. Clean area around Filterra

- Clean area around unit and remove all refuse to be disposed of appropriately.



7. Complete paperwork

- Deliver Maintenance Report and photographs to appropriate location (normally Contech during maintenance contract period).
- Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations.

Maintenance Checklist

Drainage System Failure	Problem	Conditions to Check	Condition that Should Exist	Actions
Inlet	Excessive sediment or trash accumulation.	Accumulated sediments or trash impair free flow of water into Filterra.	Inlet should be free of obstructions allowing free distributed flow of water into Filterra.	Sediments and/or trash should be removed.
Mulch Cover	Trash and floatable debris accumulation.	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover.	Trash and debris should be removed and mulch cover raked level. Ensure bark nugget mulch is not used.
Mulch Cover	"Ponding" of water on mulch cover.	"Ponding" in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover.	Recommend contact manufacturer and replace mulch as a minimum.
Vegetation	Plants not growing or in poor condition.	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact manufacturer for advice.
Vegetation	Plant growth excessive.	Plants should be appropriate to the species and location of Filterra.		Trim/prune plants in accordance with typical landscaping and safety needs.
Structure	Structure has visible cracks.	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks.		Vault should be repaired.

Maintenance is ideally to be performed twice annually.

Filterra Inspection & Maintenance Log

Filterra System Size/Model: _____ Location: _____

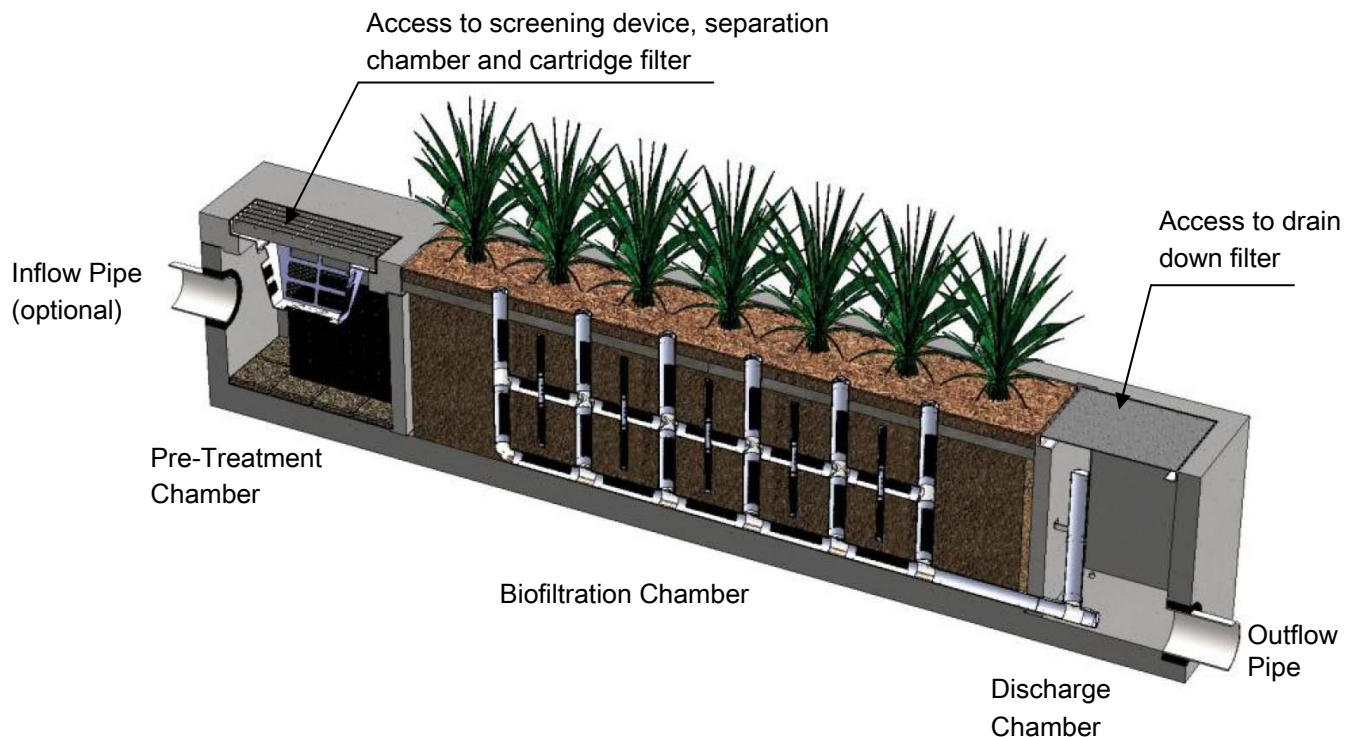
Date	Mulch & Debris Removed	Depth of Mulch Added	Mulch Brand	Height of Vegetation Above Grate	Vegetation Species	Issues with System	Comments
1/1/17	5 – 5 gal Buckets	3"	Lowe's Premium Brown Mulch	4'	Galaxy Magnolia	- Standing water in downstream structure	- Removed blockage in downstream structure

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
 - *(5 minute average service time).*
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
 - *(10 minute average service time).*
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
 - *(10-15 minute per cartridge average service time).*
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
 - *(5 minute average service time).*
- Trim Vegetation – average maintenance interval is 6 to 12 months.
 - *(Service time varies).*

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.



Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.
2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.
3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
4. Entry into chambers may require confined space training based on state and local regulations.
5. No fertilizer shall be used in the Biofiltration Chamber.
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.



Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.



Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.





Inspection Form



Modular Wetland System, Inc.

P. 760.433-7640

F. 760-433-3176

E. Info@modularwetlands.com

www.modularwetlands.com



Inspection Report Modular Wetlands System



Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____

Phone () -

Inspector Name _____

Date ____ / ____ / ____ Time ____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____

Additional Notes _____

For Office Use Only

(Reviewed By)

(Date)
Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	Yes	No	Comments
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	Yes	No
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____



Maintenance Report



Modular Wetland System, Inc.

P. 760.433-7640

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www.modularwetlands.com



Cleaning and Maintenance Report Modular Wetlands System



Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____

Phone () -

Inspector Name _____

Date ____ / ____ / ____ Time ____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint

☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____

Additional Notes _____

For Office Use Only

(Reviewed By)

(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat:	MWS Catch Basins						
	Long:							
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:



BAYFILTER™ STORMWATER FILTRATION SYSTEM



NJCAT/NJDEP VERIFICATION HIGHLIGHTS

- **Superior Treatment Flow:** Up to 45 GPM per cartridge for smaller, more economical systems.
- **Outstanding Service Life:** One BayFilter 545 cartridge captures 262 pounds of sediment (out of 315 pounds loaded during testing).
- **Sustained Performance:** The BayFilter 545 demonstrated an average sediment removal efficiency of 83.1% over the course of 70 test runs.

WASHINGTON DEPARTMENT OF ECOLOGY (TAPE) FINDINGS OF FACT

- TSS removal efficiency greater than 80%
- Mean phosphorus reduction of 64%
- Maintenance was not required during the 18 month evaluation.
- BayFilter awarded General Use Level Designation for Basic (TSS) and Phosphorus Treatment

FEATURES:

- BayFilter offers enhanced pollutant removal for cleaner stormwater runoff.
- BayFilter systems remove greater than 80% Total Suspended Solids (TSS) and 65% of turbidity
- Easy to specify, install, and maintain
- Available in different configurations (manhole filter, precast vault filter, cast-in-place vault filter, and catch basin filter)
- Systems are fully customizable
- BayFilter with enhanced media is capable of removing 65% of the total phosphorus load.
- Cartridges may be recycled
- A drain-down module is integrated into the effluent manifold system, allowing manhole/vault to empty even after siphon has broken and the cartridges are not engaged.
- Outstanding flow rate and sediment capture make BayFilter a great choice for both flow-based and volume-based designs.

For more information on BayFilter Stormwater Filtration System and other products, please contact our Customer Service Representatives at **1-800-229-7283**.





[Home](#) > [Working With Us](#) > [Engineers](#) > [BayFilter](#) : Easy Inspection. Easy Maintenance.

ENGINEERS

Easy Inspection. Easy Maintenance

Easy Inspection

When BayFilter is initially installed, we recommend that an inspection be performed on the system in the first six (6) months. After that, the inspection cycle typically falls into a bi-annual pattern given normal storm occurrence and actual solids loads. Its easy access design, whether manhole or pre-cast vault, assures unobstructed and effortless on-the-spot inspection of any BayFilter system.

Easy Maintenance.

The BayFilter system requires periodic maintenance to continue operating at its peak efficiency design. The maintenance process comprises the removal and replacement of each BayFilter cartridge and the cleaning of the vault or manhole with a vacuum truck. For best results, BayFilter maintenance should be performed by a BaySaver Technologies certified maintenance contractor. A quick call to a BaySaver engineer or customer service representative will provide you with a list of reliable contractors in your area.

The maintenance cycle of the BayFilter system is driven mainly by the actual solids load on the filter. It is prudent to periodically monitor the system to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

When BayFilter exhibits flows below design levels, the system should be inspected and maintained as soon as practical. Replacing a BayFilter cartridge should be considered at or above the level of the 4" collector pipes to the manifold. The following maintenance procedures can also be found in the BayFilter System Technical and Design Manual.

BayFilter Maintenance Procedures

1. Remove the manhole covers and open all access hatches.
2. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O₂, high CO, or other applicable warning devices per regulatory requirements.
3. Using a vacuum truck, remove any liquid and sediments that can be removed prior to entry.
4. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.
5. Any cartridges that cannot be readily lifted can be easily slid along the floor to a location they can be lifted via a boom lift.
6. When all the cartridges have been removed, it is now practical to remove the balance of the solids and water. Loosen the stainless clamps on the Fernco couplings for the manifold and remove the drainpipes as well. Carefully cap the manifold and the Fernco's and rinse the floor, washing away the balance of any remaining collected solids.
7. Clean the manifold pipes, inspect, and reinstall.
8. Install the exchange cartridges and close all covers.
9. The used cartridges must be sent back to BaySaver Technologies for exchange/recycling and credit on undamaged units.

BAYFILTER™ INSPECTION AND MAINTENANCE MANUAL

The BayFilter system requires periodic maintenance to continue operating at the design efficiency. The maintenance process is comprised of the removal and replacement of each BayFilter cartridge, vertical drain down module; and the cleaning of the vault or manhole with a vacuum truck.

The maintenance cycle of the BayFilter system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

BayFilter systems in volume-based applications are designed to treat the WQv in 24 to 48 hours initially. Late in the operational cycle of the BayFilter, the flow rate will diminish as a result of occlusion. When the drain down exceeds the regulated standard, maintenance should be performed.

When a BayFilter system is first installed, it is recommended that it be inspected every six (6) months. When the filter system exhibits flows below design levels the system should be maintained. Filter cartridge replacement should also be considered when sediment levels are at or above the level of the manifold system. Please contact the BaySaver Technologies Engineering Department for maintenance cycle estimations or assistance at **1.800.229.7283**.



BayFilter System Cleanout



Vector Truck Maintenance



Jet Vactoring Through Access Hatch

Maintenance Procedures

1. Contact BaySaver Technologies for replacement filter cartridge pricing and availability at 1-800-229-7283.
2. Remove the manhole covers and open all access hatches.
3. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O₂, high CO, or other applicable warning devices per regulatory requirements.
4. Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.
5. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.
6. Any cartridges that cannot be readily lifted can be easily slid along the floor to a location they can be lifted via a boom lift.
7. When all the cartridges have been removed, it is not practical to remove the balance of the solids and water. Loosen the stainless clamps on the Fernco couplings for the manifold and remove the drain pipes as well. Carefully cap the manifold and the Ferncos and rinse the floor, washing away the balance of any remaining collected solids.
8. Clean the manifold pipes, inspect, and reinstall.
9. Install the exchange cartridges and close all covers.
10. The used cartridges may be sent back to BaySaver Technologies for recycling.



Manifold Tee View of a Cleaned System



Cartridge Hoist Point

For more information please see the BaySaver website at www.baysaver.com or contact 1-800-229-7283.

THE MOST *ADVANCED* NAME IN WATER MANAGEMENT SOLUTIONS™

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com



Aqua-Swirl®
Stormwater Treatment System
Inspection and Maintenance Manual



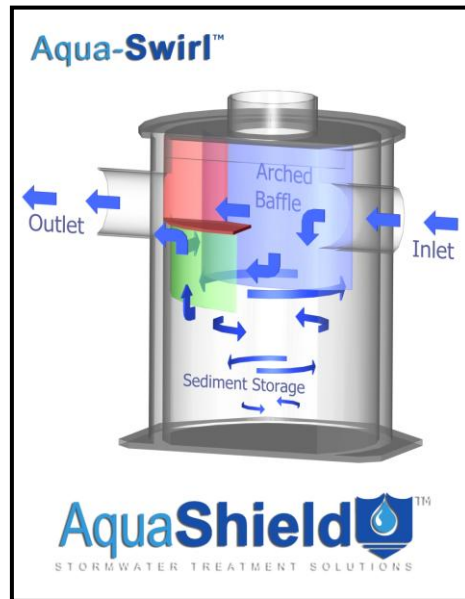
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Aqua-Swirl® Stormwater Treatment System

The Aqua-Swirl® Stormwater Treatment System (Aqua-Swirl®) is a vortex-type hydrodynamic separator designed and supplied by AquaShield™, Inc. (AquaShield™). Aqua-Swirl® technology removes pollutants including suspended solids, debris, floatables and free-floating oil from stormwater runoff. Both treatment and storage are accomplished in the single swirl chamber without the use of multiple or hidden, blind access chambers.



Aqua-Swirl® Stormwater Treatment System



Floatable debris in the Aqua-Swirl®



System Operation

The treatment operation begins when stormwater enters the Aqua-Swirl[®] through a tangential inlet pipe that produces a circular (or vortex) flow pattern that causes contaminants to settle to the base of the unit. Since stormwater flow is intermittent by nature, the Aqua-Swirl[®] retains water between storm events providing both dynamic and quiescent settling of solids. The dynamic settling occurs during each storm event while the quiescent settling takes place between successive storms. A combination of gravitational and hydrodynamic drag forces encourages the solids to drop out of the flow and migrate to the center of the chamber where velocities are the lowest.

The treated flow then exits the Aqua-Swirl[®] behind the arched outer baffle. The top of the baffle is sealed across the treatment channel, thereby eliminating floatable pollutants from escaping the system. A vent pipe is extended up the riser to expose the backside of the baffle to atmospheric conditions, preventing a siphon from forming at the bottom of the baffle.



Custom Applications

The Aqua-Swirl[®] system can be modified to fit a variety of purposes in the field, and the angles for inlet and outlet lines can be modified to fit most applications. The photo below demonstrates the flexibility of Aqua-Swirl[®] installations using a “twin” configuration in order to double the water quality treatment capacity. Two Aqua-Swirl[®] units were placed side by side in order to treat a high volume of water while occupying a small amount of space.



Custom designed AS-9 Twin Aqua-Swirl[®]



Retrofit Applications

The Aqua-Swirl[®] system is designed so that it can easily be used for retrofit applications. With the invert of the inlet and outlet pipe at the same elevation, the Aqua-Swirl[®] can easily be connected directly to the existing storm conveyance drainage system. Furthermore, because of the lightweight nature and small footprint of the Aqua-Swirl[®], existing infrastructure utilities (i.e., wires, poles, trees) would be unaffected by installation.



Aqua-Swirl[®] System Maintenance

The long term performance of any stormwater treatment structure, including manufactured or land based systems, depends on a consistent maintenance plan. Inspection and maintenance functions are simple and easy for the Aqua-Swirl[®] allowing all inspections to be performed from the surface.

It is important that a routine inspection and maintenance program be established for each unit based on: (a) the volume or load of the contaminants of concern, (b) the frequency of releases of contaminants at the facility or location, and (c) the nature of the area being drained.

In order to ensure that our systems are being maintained properly, AquaShield[™] offers a maintenance solution to all of our customers. We will arrange to have maintenance performed.



Aqua-Swirl[®] manhole cover



Inspection

The Aqua-Swirl[®] can be inspected from the surface, eliminating the need to enter the system to determine when cleanout should be performed. In most cases, AquaShield[™] recommends a quarterly inspection for the first year of operation to develop an appropriate schedule of maintenance. Based on experience of the system's first year in operation, we recommend that the inspection schedule be revised to reflect the site-specific conditions encountered. Typically, the inspection schedule for subsequent years is reduced to semi-annual inspection.



Maintenance

The Aqua-Swirl[®] has been designed to minimize and simplify the inspection and maintenance process. The single chamber system can be inspected and maintained entirely from the surface thereby eliminating the need for confined space entry. Furthermore, the entire structure (specifically, the floor) is accessible for visual inspection from the surface. There are no areas of the structure that are blocked from visual inspection or periodic cleaning. Inspection of any free-floating oil and floatable debris can be directly observed and maintained through the manhole access provided directly over the swirl chamber.

Aqua-Swirl[®] Inspection Procedure

To inspect the Aqua-Swirl[®], a hook is typically needed to remove the manhole cover. AquaShield[™] provides a customized manhole cover with our distinctive logo to make it easy for maintenance crews to locate the system in the field. We also provide a permanent metal information plate affixed inside the access riser which provides our contact information, the Aqua-Swirl[®] model size, and serial number.

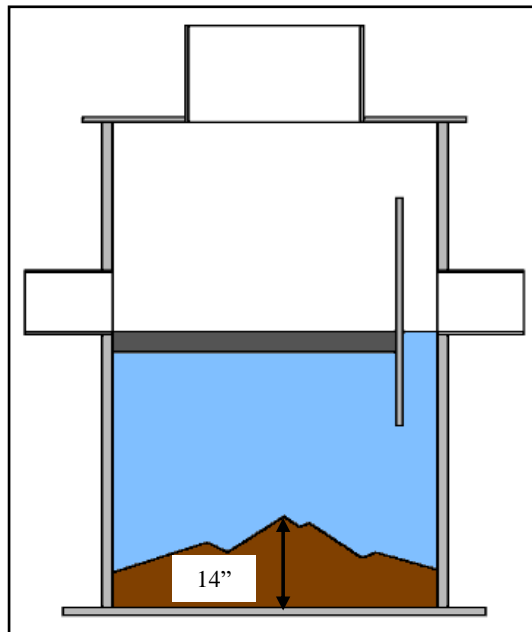
The only tools needed to inspect the Aqua-Swirl[®] system are a flashlight and a measuring device such as a stadia rod or pole. Given the easy and direct accessibility provided, floating oil and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device to the top of the sediment pile and to the surface of the water.

It should be noted that in order to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the *top* of the sediment pile. Keep in mind that the finer sediment at the top of the pile may offer less resistance to the measuring device than the larger particles which typically occur deeper within the sediment pile.

The Aqua-Swirl[®] design allows for the sediment to accumulate in a semi-conical fashion as illustrated below. That is, the depth to sediment as measured below the water surface may be less in the center of the swirl chamber; and likewise, may be greater at the edges of the swirl chamber.



Sediment inspection using a stadia rod



Maximum recommended sediment depth prior to cleanout is 14 inches for all Aqua-Swirl® models

Aqua-Swirl® Cleanout Procedure

Cleaning the Aqua-Swirl® is simple and quick. Free-floating oil and floatable debris can be observed and removed directly through the 30-inch service access riser provided. A vacuum truck is typically used to remove the accumulated sediment and debris. An advantage of the Aqua-Swirl® design is that the entire sediment storage area can be reached with a vacuum hose

from the surface reaching all the sides. Since there are no multiple or limited (blind) access chambers in the Aqua-Swirl[®], there are no restrictions to impede on-site maintenance tasks.

Disposal of Recovered Materials

AquaShield[™] recommends that all maintenance activities be performed in accordance with appropriate health and safety practices for the tasks and equipment being used. AquaShield[™] also recommends that all materials removed from the Aqua-Swirl[®] and any external structures (e.g, bypass features) be handled and disposed in full accordance with any applicable local and state requirements.



Vacuum (vactor) truck quickly cleans the single open access swirl chamber

***Aqua-Swirl[®] Inspection and Maintenance Work Sheets
on following pages***

Aqua-Swirl[®] Inspection and Maintenance Manual

Work Sheets

SITE and OWNER INFORMATION

Site Name: _____

Site Location: _____

Date: _____ Time: _____

Inspector Name: _____

Inspector Company: _____ Phone #: _____

Owner Name: _____

Owner Address: _____

Owner Phone #: _____ Emergency Phone #: _____

INSPECTIONS

I. Floatable Debris and Oil

1. Remove manhole lid to expose liquid surface of the Aqua-Swirl[®].
2. Remove floatable debris with basket or net if any present.
3. If oil is present, measure its depth. Clean liquids from system if one half (1/2) inch or more oil is present.

Note: Water in Aqua-Swirl[®] can appear black and similar to oil due to the dark body of the surrounding structure. Oil may appear darker than water in the system and is usually accompanied by oil stained debris (e.g. Styrofoam, etc.). The depth of oil can be measured with an oil/water interface probe, a stadia rod with water finding paste, a coliwasa, or collect a representative sample with a jar attached to a rod.

II. Sediment Accumulation

1. Lower measuring device (e.g. stadia rod) into swirl chamber through service access provided until top of sediment pile is reached.
2. Record distance to top of sediment pile from top of standing water: _____ inches.
3. Maximum recommended sediment depth prior to cleanout is 14 inches for all models. Consult system shop drawing for treatment chamber depth as measured from the inlet pipe invert to base of the unit.

III. Diversion Structures (External Bypass Features)

If a diversion (external bypass) configuration is present, it should be inspected as follows:

1. Inspect weir or other bypass feature for structural decay or damage. Weirs are more susceptible to damage than off-set piping and should be checked to confirm that they are not crumbling (concrete or brick) or decaying (steel).
2. Inspect diversion structure and bypass piping for signs of structural damage or blockage from debris or sediment accumulation.
3. When feasible, measure elevations on diversion weir or piping to ensure it is consistent with site plan designs.
4. Inspect downstream (convergence) structure(s) for sign of blockage or structural failure as noted above.

CLEANING

Schedule cleaning with local vacuor company or AquaShield™ to remove sediment, oil and other floatable pollutants. The captured material generally does not require special treatment or handling for disposal. Site-specific conditions or the presence of known contaminants may necessitate that appropriate actions be taken to clean and dispose of materials captured and retained by the Aqua-Swirl®. All cleaning activities should be performed in accordance with property health and safety procedures.

AquaShield™ always recommends that all materials removed from the Aqua-Swirl® during the maintenance process be handled and disposed in accordance with local and state environmental or other regulatory requirements.

MAINTENANCE SCHEDULE

I. During Construction

Inspect the Aqua-Swirl® every three (3) months and clean the system as needed. The Aqua-Swirl® should be inspected and cleaned at the end of construction regardless of whether it has reached its maintenance trigger.

II. First Year Post-Construction

Inspect the Aqua-Swirl® every three (3) months and clean the system as needed.

Inspect and clean the system once annually regardless of whether it has reached its sediment or floatable pollutant storage capacity.

III. Second and Subsequent Years Post-Construction

If the Aqua-Swirl® did not reach full sediment or floatable pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned once annually.

If the Aqua-Swirl[®] reached full sediment or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months and cleaned as needed. The Aqua-Swirl[®] should be cleaned annually regardless of whether it reaches its sediment or floatable pollutant capacity.

IV. Bypass Structures

Bypass structures should be inspected whenever the Aqua-Swirl[®] is inspected. Maintenance should be performed on bypass structures as needed.

MAINTENANCE COMPANY INFORMATION

Company Name: _____

Street Address: _____

City: _____ State/Prov.: _____ Zip/Postal Code: _____

Contact: _____ Title: _____

Office Phone: _____ Cell Phone: _____

ACTIVITY LOG

Date of Cleaning: _____ (Next inspection should be 3 months from this data for first year).

Time of Cleaning: Start: _____ End: _____

Date of Next Inspection: _____

Floatable debris present: Yes No

Notes: _____

Oil present: Yes No Oil depth (inches): _____

Measurement method and notes: _____

STRUCTURAL CONDITIONS and OBSERVATIONS

Structural damage: Yes No Where: _____

Structural wear: Yes No Where: _____

Odors present: Yes No Describe: _____

Clogging: Yes No Describe: _____

Other Observations: _____

NOTES

Additional Comments and/or Actions To Be Taken	Time Frame

ATTACHMENTS

- Attach site plan showing Aqua-Swirl[®] location.
- Attach detail drawing showing Aqua-Swirl[®] dimensions and model number.
- If a diversion configuration is used, attach details showing basic design and elevations (where feasible).

Aqua-Swirl®

TABULAR MAINTENANCE SCHEDULE

Date Construction Started: _____

Date Construction Ended: _____

During Construction

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Inspect and Clean as needed			X			X			X			X
Inspect Bypass and maintain as needed			X			X			X			X
Clean System*												X*

* The Aqua-Swirl® should be cleaned **once a year** regardless of whether it has reached full pollutant storage capacity. In addition, the system should be cleaned at the **end of construction** regardless of whether it has reach full pollutant storage capacity.

First Year Post-Construction

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Inspect and Clean as needed			X			X			X			X
Inspect Bypass and maintain as needed			X			X			X			X
Clean System*												X*

* The Aqua-Swirl® should be cleaned **once a year** regardless of whether it has reached full pollutant storage capacity.

Second and Subsequent Years Post-Construction

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Inspect and Clean as needed												X*
Inspect Bypass, maintain as needed												X*
Clean System*												X*

* If the Aqua-Swirl® did **not** reach full sediment or floatable pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned once annually.

If the Aqua-Swirl® **reached** full sediment or floatable pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months or more frequently if past history warrants, and cleaned as needed. The Aqua-Swirl® should be cleaned annually regardless of whether it reaches its full sediment or floatable pollutant capacity.